

Rotations

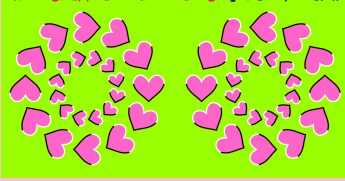
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Check out these other files

Reflections
Translations
Dilations

Transforming Geometry into the Common Core with Transformations

Do the rings appear to be rotating? It's an optical illusion.



with an
Interactive
Notebook
foldable

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<http://www.psy.tsumet.ac.jp/~akitaoka/rotate23a.html>

<http://GeometryGems.wikispaces.com/Imagination>

Rotations

Rotations

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Transformations

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Menu

- Common Core Standards
- History and information about transformations
- Rotations
- Using this file
- Foldables - student and teacher copies

Table of Contents

Grade 8 Geometry

Understand congruence and similarity using physical models, transparencies, or geometry software.

- > [CCSS.Math.Content.8.G.A.1](#) Verify experimentally the properties of rotations, reflections, and translations:
 - « [CCSS.Math.Content.8.G.A.1a](#) Lines are taken to lines, and line segments to line segments of the same length.
 - « [CCSS.Math.Content.8.G.A.1b](#) Angles are taken to angles of the same measure.
 - « [CCSS.Math.Content.8.G.A.1c](#) Parallel lines are taken to parallel lines.
- > [CCSS.Math.Content.8.G.A.2](#) Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

Grade 8 Geometry p.1

Grade 8 Geometry (cont.)

Understand congruence and similarity using physical models, transparencies, or geometry software.

- > [CCSS.Math.Content.8.G.A.3](#) Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
- > [CCSS.Math.Content.8.G.A.4](#) Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

Grade 8 Geometry p.2

High School Geometry

Understand similarity in terms of similarity transformations

- > [CCSS.Math.Content.HSG-SRT.A.1](#) Verify experimentally the properties of dilations given by a center and a scale factor:
 - « [CCSS.Math.Content.HSG-SRT.A.1a](#) A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
 - « [CCSS.Math.Content.HSG-SRT.A.1b](#) The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

HS Geometry p.1

High School Geometry (cont.)

Understand similarity in terms of similarity transformations

- > [CCSS.Math.Content.HSG-SRT.A.2](#) Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- > [CCSS.Math.Content.HSG-SRT.A.3](#) Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

HS Geometry p.2

Common Core Math Practices

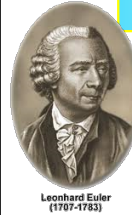
The CCSSM expects mathematically proficient geometry students to

- experiment,
- explain,
- prove,
- visualize,
- understand,
- derive, and
- translate between representations.

Students are expected to demonstrate **geometric habits of mind**, and be **proficient** in the Standards of Mathematical Practice.

CCSS Math Practices

Transformations



The first use of transformations dates back to the ancient Greeks around the time of Euclid. However, not until Euler (in 1776) did anyone identify all the kinds of transformations in space that could yield congruent figures.

It is interesting that the 3-dimensional analysis of congruence was accomplished before the 2-dimensional. This is probably because the congruent objects seen daily are 3-dimensional.

Transformation History

rotations translations dilations reflections

A **transformation** is a correspondence between sets of points such that each point in the image has exactly one preimage point.

Transofrmation

Why study transformations?

- Studying these various transformations helps a person to become more aware of the movements of objects such as gears (which rotate) and conveyer belts (which slide).
- More complicated movements, such as those done by robots, can be taken apart into their component moves and analyzed.
- Transformations also appear in music and help to show some connections between mathematics and music.
- Things like cartoons, comics, flip books, storyboards, how-to books, and picture instructions use transformations to show motion

Why study transformations?

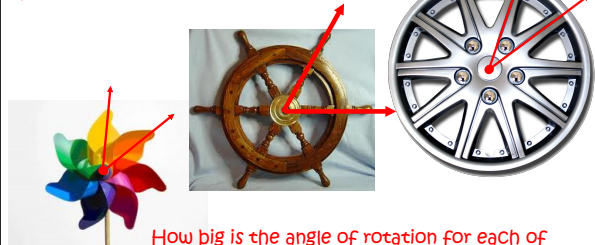
Definition

Rotation or "Turn"

A **rotation R** is a transformation of the plane that is the composite of two reflections over intersecting lines; the transformation **turns** the pre-image onto the image about a **CENTER**.

Rotation

Things that rotate...



How big is the angle of rotation for each of these? Can you figure it out without a protractor?

What other things can you think of that show rotations?

Angles of rotation

Rotations

We turn frequently to see objects or to hear better or to move from one place to another. Hands on clocks turn, combination locks often involve turning, and wheels turn. The mathematical model for a turn is a **rotation**.

$$r_n(r_m(\triangle ABC)) = R_{G, \text{degrees}(\triangle ABC) - \triangle A'B'C'}$$

Rotation of $\triangle ABC$ degrees° about center G

Notation

The magnitude (or amount of turn) of rotation may be any real number.

- If the magnitude is **positive**, the rotation is **counterclockwise**.
- If the magnitude is **negative**, the rotation is **clockwise**.

Magnitudes of rotations

$$r_n(r_m(\triangle ABC)) = R_{G, \text{degrees}(\triangle ABC) - \triangle A'B'C'}$$

Rotation of $\triangle ABC$ degrees° about center G

Challenge

Rotations over intersecting lines 1

$$R_{G, 150}(\triangle ABC) = \triangle A'B'C'$$

Rotation of $\triangle ABC$ 100° about center G

Rotations over intersecting lines 2

I can only measure one existing angle made by the intersecting lines m and n (without drawing other angles) to find the angle of rotation. Which one should I measure? Prove it!

Did you figure it out?

Prove it!

One possible proof

Proof

Quiz Yourself

Convert R_{-400} to a rotation with a magnitude in the range of -180° to 180° .

Hints

- Negative angles are rotating clockwise.
- There are 360° in one full rotation.
- Find the angle left after taking away any full circles.

Answer

- 400 - (-1)360 = - 40° so, R_{-40}

Quiz

Music

Rotations can be useful in picturing repeating patterns.

Example: On a piano keyboard, the notes repeat themselves as shown below.

The **three marked keys** form a C-major chord.

To find the notes of other major chords, place the possible notes on a circle and then rotate the triangle clockwise about the center O of the circle.

Piano chords

C# D# F# G# A# C#

C D E F G A B C D

piano

Diagram of a circle with 12 notes: G \sharp , A, A \sharp , B, C, C \sharp , D, D \sharp , E, F, F \sharp , G. A triangle is formed by connecting C, E, and G \sharp . The note D \sharp is circled in red.

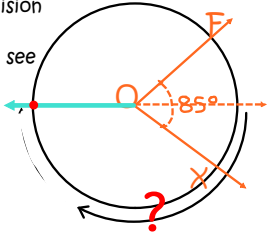

chord question

Case No.	Case Name	Case Type	Case Status	Case Date	Case Time	Case Location	Case Description	Case Notes	Case Comments
1	John Doe	Medical	Open	2023-10-27	10:30	Room 101	John Doe, 45 years old, male, presented with chest pain and shortness of breath. Vital signs: BP 120/80, HR 95, RR 20, SpO2 98%.	ECG showed sinus tachycardia. Chest X-ray showed clear lung fields.	Admitted to the medical ward for further observation and treatment.
2	Jane Smith	Medical	Closed	2023-10-26	14:15	Room 202	Jane Smith, 60 years old, female, presented with a fall from a height of 10 feet. Injuries: laceration on the forehead, bruising on the right arm.	Wound was cleaned and sutured. No fractures were detected on X-ray.	Discharged home with instructions for wound care and pain management.
3	Michael Brown	Medical	Open	2023-10-27	08:45	Room 303	Michael Brown, 30 years old, male, presented with abdominal pain and nausea. Vital signs: BP 110/70, HR 100, RR 18, SpO2 96%.	Abdominal exam showed tenderness in the right lower quadrant.	Admitted to the medical ward for further evaluation and treatment.
4	Sarah Johnson	Medical	Closed	2023-10-25	16:00	Room 404	Sarah Johnson, 55 years old, female, presented with a headache and dizziness. Vital signs: BP 130/90, HR 80, RR 16, SpO2 99%.	Head CT scan showed no acute abnormalities.	Discharged home with a prescription for pain medication.
5	David Wilson	Medical	Open	2023-10-27	12:00	Room 505	David Wilson, 70 years old, male, presented with confusion and slurred speech. Vital signs: BP 140/90, HR 110, RR 22, SpO2 97%.	Neurological exam showed mild left-sided weakness.	Admitted to the medical ward for further evaluation and treatment.
6	Emily Davis	Medical	Closed	2023-10-24	09:30	Room 606	Emily Davis, 25 years old, female, presented with a laceration on the forearm. Vital signs: BP 100/60, HR 70, RR 14, SpO2 98%.	Wound was cleaned and sutured. No fractures were detected on X-ray.	Discharged home with instructions for wound care and pain management.
7	Robert Miller	Medical	Open	2023-10-27	15:45	Room 707	Robert Miller, 65 years old, male, presented with chest pain and sweating. Vital signs: BP 150/100, HR 120, RR 24, SpO2 95%.	ECG showed ST-segment elevation.	Admitted to the medical ward for further evaluation and treatment.
8	Lisa Anderson	Medical	Closed	2023-10-23	11:00	Room 808	Lisa Anderson, 40 years old, female, presented with a fall from a height of 5 feet. Injuries: laceration on the knee, bruising on the right leg.	Wound was cleaned and sutured. No fractures were detected on X-ray.	Discharged home with instructions for wound care and pain management.
9	James Taylor	Medical	Open	2023-10-27	07:15	Room 909	James Taylor, 50 years old, male, presented with abdominal pain and vomiting. Vital signs: BP 120/80, HR 100, RR 20, SpO2 98%.	Abdominal exam showed tenderness in the right upper quadrant.	Admitted to the medical ward for further evaluation and treatment.
10	Maria Garcia	Medical	Closed	2023-10-22	13:30	Room 1010	Maria Garcia, 35 years old, female, presented with a headache and dizziness. Vital signs: BP 130/90, HR 80, RR 16, SpO2 99%.	Head CT scan showed no acute abnormalities.	Discharged home with a prescription for pain medication.

piano

Rotations

Example: A fox has a limited field of view. If the fox's field of vision is 85° , how much of a turn is necessary so that the fox can see what is directly behind it?



Answer:


field of vision

Rotation Challenge

Given points A and C, draw the image of point A under a rotation of 160° about point C. Label the image A'.

Find two intersecting lines that A can be reflected over to find A' and what has to be true of the line? Why?

rotation challenge



"turn"

2 Definition:

click here

Notation:

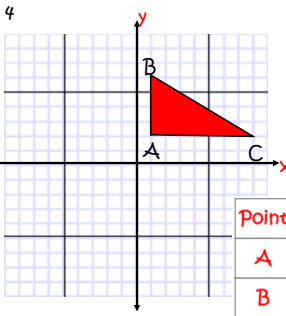
click here

3 Properties:

click here

foldable info

4



Use the "spinner" on your foldable. Trace the axes and the triangle ABC. Turn the "spinner" to find the coordinates when rotated 90° , 180° , and 270° .

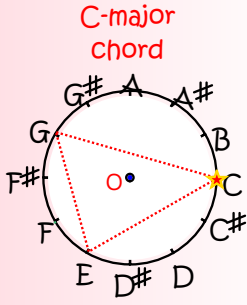
Point	(x,y)	90°	180°	270°
A				
B				
C				
	(x,y)			

5

Rotation-Tchr

6

C-major	C-E-G
D-major	
F-major	



C-major chord

Rotation-Tchr

Thank you...

Go forth and TRANSFORM the World!

Find the handouts, presentations in both SMART Board and .PDF formats at:

<http://GeometryGems.wikispaces.com/iMathinationResources/References>

Geometry, 3rd Edition - The University of Chicago School Math Project by John Benson, Ray Klein, Matthew Miller, Catherine Capuzzi-Feuerstein, Michael Fletcher, George Marino, Nancy Norem Powell, Natalie Jakucyn, and Zalman Usiskin. McGraw Hill/Wright Group, 2009.

Contact me at:

nancynpowell@gmail.com

Thank you

Create Activities for Your SMART™ Board, 2nd Edition

Discounts are available for multiple books. Become a Friend of **Visions Technology** on Facebook and find notifications of more free Notebook files to download.

<http://www.toolsforteachers.com/home/vtc/create-activities-for-your-smart-board>

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Resources for your SMART™ Board Geometry lessons
<http://GeometryGems.wikispaces.com/>

Resources for your SMART™ Board Math lessons
<http://GreenApples.wikispaces.com/>

For even more resources...

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Resources

Foldables to put into an interactive notebook

To print these, make sure to read the directions


Foldables

Information

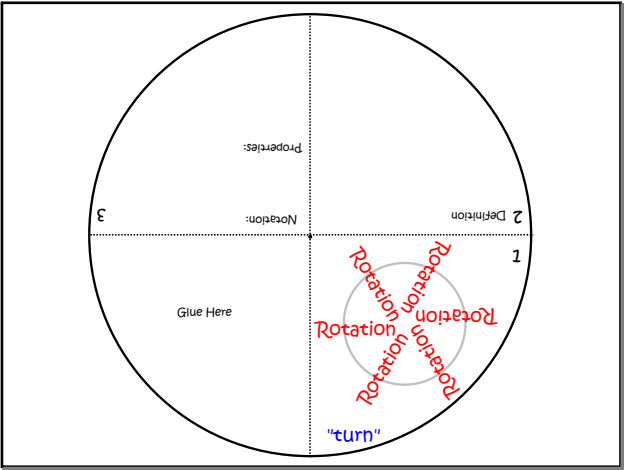
The foldable note sheets are meant to give students a place to summarize their findings and should in no instance substitute for explorations and investigations that will help students understand transformations/translations. Take time to do the activities in this file and add other activities that will enrich students' understanding of transformations/reflections.

A set of foldable student notes and samples of teacher answers are included.

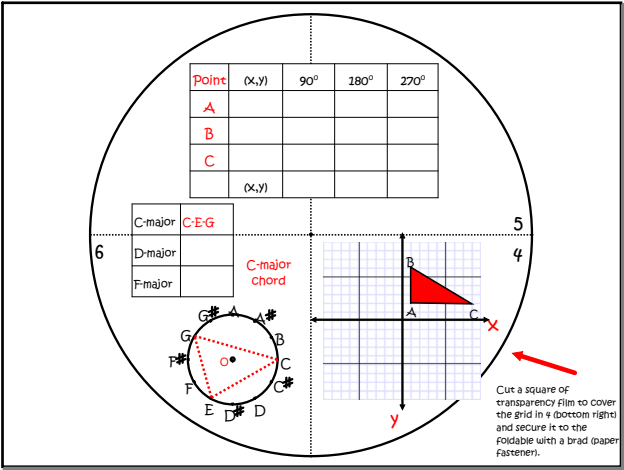
1. There are notes for rotations in this file (reflections, translations, and dilations are available in their files). Each set is two pages. If you are downloading the SMART Notebook file, you can easily edit them.
2. These notes are intended to be printed double sided and printed in color. If you print them, print them **landscaped, duplex** (double-sided) and make sure they flip on the **short edge** so the front lines up with the back. If you choose not to print them in color, students can easily add their own color to the notes.
3. The notes should be cut out and folded on the dotted lines. Pictures are on <http://GeometryGems.wikispaces.com/iMathination/> to show you what these notes look like when they are folded.



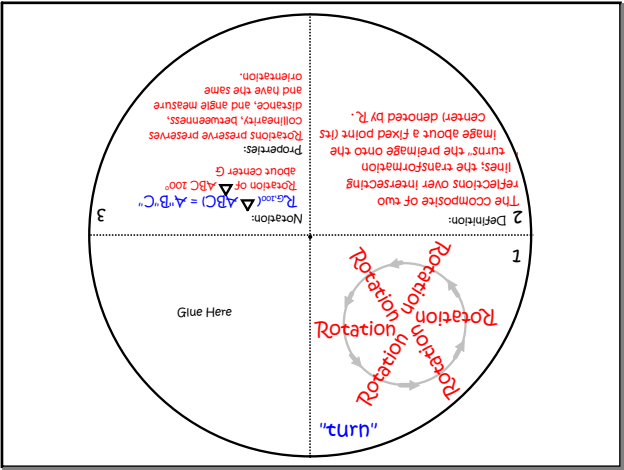
Foldable instructions



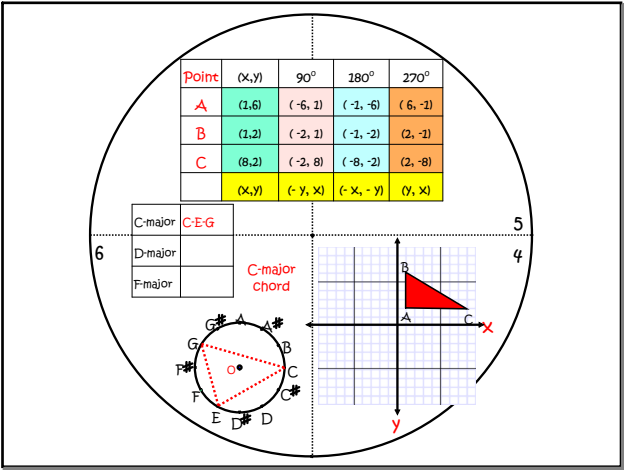
Rotation - Student page 1



Rotation - Student page 2



Rotation - Teacher page 1



Rotation - Teacher page 2